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FORMERLY WILLOW RUN LABORATORIES, THE UNIVERSITY OF MICHIGAN

P. O. BOX 618 • ANN ARBOR • MICHIGAN • 48107

PHONE (313) 483-0500

(E73-10483) USE OF ERTS DATA FOR A  
MULTIDISCIPLINARY ANALYSIS OF MICHIGAN  
RESOURCES Progress Report, 1 Feb. - 21  
Mar. 1973 (Environmental Research Inst.  
of Michigan) 11 p HC \$3.00 CSCL 08F

N73-21320

Unclas

G3/13 00483

Michigan State University  
East Lansing, Michigan 48823

Attention: Dr. Axel Andersen  
Project Coordinator  
Room 158, Plant Biology Building

Reference: Subcontracts 1 and 2 of NAS5-21834

Subject: Type I Progress Report for Period 1 February 1973  
through 21 March 1973

Dear Sir:

The following is a bimonthly progress report for the two referenced subcontracts under the Earth Resources Technology Satellite (ERTS) contract entitled, "Use of ERTS Data for a Multidisciplinary Analysis of Michigan Resources".

Work on these subcontracts was performed within the Infrared and Optics Division, directed by Mr. Richard Legault, under the supervision of Dr. Jon D. Erickson, Head of the Information Systems and Analysis Department and a co-investigator on the prime contract.

SUBCONTRACT NO. 1  
DATA PROCESSING AND ANALYSIS SUPPORT

Introduction

The objectives of this subcontract are to apply standard multispectral recognition processing procedures to ERTS-1 multispectral scanner (MSS) data and related airborne MSS underflight data, and to assist MSU personnel in the analysis and interpretation of recognition maps and other extracted information in working toward the goals of the prime contract.

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ERTS-1 data in digital form on computer-compatible tapes (CCT's) is being used for the application of the multispectral recognition processing and analysis techniques. The one ERTS frame suitable for analysis was collected on 25 Aug. 1973.

Data processing and analysis support is being provided for three separate tasks, each with its own MSU principal investigator: (1) Forestry, Dr. Wayne Myers, (2) Agriculture, Dr. Gene Safir, and (3) Soils and Land-forms, Dr. Eugene Whiteside.

#### Progress During the Period, 1 February - 21 March 1973

The main efforts during the reporting period were devoted to the Agriculture and Forestry Tasks; the Soils Task is awaiting new data with more bare soil in the scene.

The principal work was related to the paper\* presented at the ERTS Symposium on Significant Results, Mar. 5-9, 1973. An additional 18 test plots were located in the ERTS MSS (multispectral scanner) data, beyond those reported in the semi-annual progress report. Recognition was carried out for these plots and the results were incorporated into the analysis summary presented at the Symposium. ERIM personnel also contributed to the final text of the presented paper.

A problem in the recognition of forests was identified by W. Myers during the last reporting period, namely, the misclassification of pixels that represent sparsely forested areas on the perimeters of woodlots. He identified 300 points in this category and we extracted values for them from the ERTS CCT data. One quarter of these points were used to determine a "sparse forest" signature. This signature is very similar to that of corn. One previous recognition run was repeated, with an additional signature and a recognition class for "sparse forest". Our cursory examination of the resulting recognition map indicated a good recognition of the sparse forest points, along with a large number of erroneous sparse forest classifications in corn fields. The recognition map was forwarded to MSU for detailed analysis. Final conclusions about the solvability of this problem should not be drawn until more analysis is performed.

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\*"Application of ERTS-1 Data to Analysis of Agricultural Crops and Forests in Michigan", by Gene R. Safir, Wayne L. Myers, William A. Malila and James P. Morgenstern.

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Several of the previously mentioned test plots, added to our analysis, contained bare soil. They are listed as plots AA-KK in Table I. Also listed are the four plots (B, C, D, and E) used for training purposes, as well as four other plots (F, G, H, I) identified by Prof. Whiteside and D. Mokma in the soils test area North of E. Lansing. At the request of D. Mokma, the means ( $\pm$  one standard deviation) of the ERTS signals obtained for these plots are presented in Figs. 1-4 for ERTS Bands 4-7, respectively. (The zero deviation shown for plot BB in Bands 4 and 5 is due to equal values for both points used to compute the signature, and the omission of values in Band 6 for DD and HH is due to the inclusion of bad lines in Band 6.) The signal values may be converted to in-band radiance units ( $\text{mW}/\text{cm}^2\cdot\text{sr}$ ) by multiplying by the factors,  $2.48/127$ ,  $2.00/127$ ,  $1.76/127$ , and  $4.60/63$ , for Bands 4-7, respectively.

During the past few months, examples of processed MSS data products in various forms have been delivered to MSU personnel for analysis. Table II lists the products delivered to date.

#### Plans for the Next Reporting Period

We will cooperate with MSU personnel in their development of a data analysis plan for the remainder of the contract. Also, we shall investigate the consequences of using only three ERTS bands for recognition processing, instead of all four.

### SUBCONTRACT NO. 2 CROP ACREAGE ESTIMATION TECHNIQUE DEVELOPMENT

#### Introduction

The spatial resolution of the ERTS multispectral scanner (MSS) is such that a single resolution element will frequently contain a mixture of two or more scene materials. The results of this phenomenon will be errors in the classification of surface materials and inaccuracies in subsequent estimates of crop acreages. Personnel of the Environmental Research Institute of Michigan have developed techniques for estimating the proportions of unresolved materials in individual resolution elements by use of multispectral scanner data. The main objective of work under this subcontract is to apply these techniques to ERTS-1 MSS data and to determine the extent to which the accuracy of crop acreage estimates can be improved.

TABLE I . DESCRIPTION OF SOILS PLOTS\*

CODE	DESCRIPTION	LOCATION		
		COUNTY	TOWNSHIP	SECTION
B	Somewhat poorly drained, medium textured	Eaton	Roxand	14
C	Poorly drained, medium textured	Eaton	Roxand	11
D	Well drained, coarse textured	Ionia	Danby	23
E	Well drained, medium textured	Ionia	Danby	15
F	Well drained, coarse textured	Clinton	Victor	26
G	Well drained, medium textured	Clinton	Bath	6
H	Poorly drained, organic	Clinton	Bath	30
I	Poorly drained, organic	Clinton	Bath	30
AA		Eaton	Oneida	18
BB		Eaton	Roxand	13
CC		Eaton	Roxand	24
DD		Eaton	Roxand	24
EE		Eaton	Oneida	30
FF		Eaton	Oneida	31
GG		Eaton	Oneida	31
HH		Eaton	Benton	7
JJ		Eaton	Benton	18
KK		Eaton	Chester	24

\*  
B-I specified by E. Whiteside and D. Mokma  
AA-KK specified by G. Safir and W. Malila

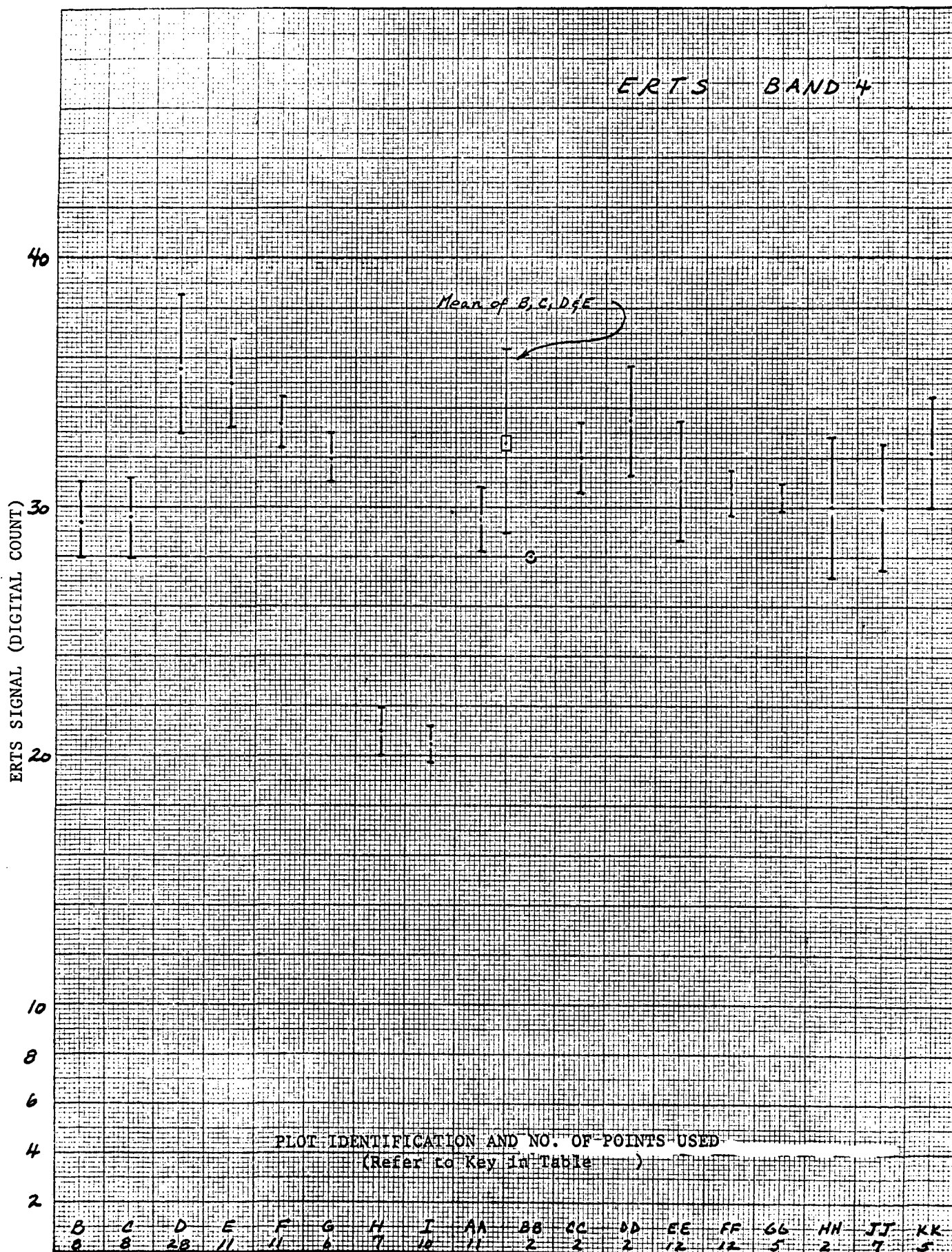


FIGURE 1 . SUMMARY OF SOIL SIGNATURES IN ERTS BAND 4  
(Frame 1033-15580)

RES 10 X 10 TO THE CENTIMETER 46 1512  
MADE IN U.S.A.  
KLUFFEL & LESSER CO.

ERTS SIGNAL (DIGITAL COUNT)

40

30

20

10

8

6

4

2

ERTS BAND 5

PLOT IDENTIFICATION AND NO. OF POINTS USED  
(Refer to Key in Table )

B	C	D	E	F	G	H	I	AA	BB	CC	DD	EE	FF	GG	HH	JJ	KK
8	8	28	11	11	6	7	10	11	2	2	2	12	12	5	2	7	5

FIGURE 2 . SUMMARY OF SOIL SIGNATURES IN ERTS BAND 5  
(Frame 1033-15580)



KE 10 X 10 TO THE CENTIMETER 4G 1512  
10 X 25 CM. MADE IN U.S.A.  
KEUFFEL & ESSER CO.

ERTS SIGNAL (DIGITAL COUNT)

40

30

20

10

8

6

4

2

ERTS BAND 6

PLOT IDENTIFICATION AND NO. OF POINTS USED  
(Refer to Key in Table )

B	C	D	E	F	G	H	I	AA	BB	CC	DD	EE	FF	GG	HH	JJ	KK
8	8	28	11	11	6	7	10	11	2	2	2	12	12	5	2	7	5

FIGURE 3 . SUMMARY OF SOIL SIGNATURES IN ERTS BAND -6  
(Frame 1033-15580)

KE 10 X 10 TO THE CENTIMETER 4G 15.12  
MADE IN U.S.A.  
KEUFFEL & ESSER CO.

ERTS SIGNAL (DIGITAL COUNT)

40

30

20

10

8

6

4

2

ERTS BAND 7

PLOT IDENTIFICATION AND NO. OF POINTS USED (Refer to Key in Table )																
B	C	D	E	F	G	H	I	1A	BB	CC	DD	EE	FF	GG	HH	JJ
8	8	28	11	11	6	7	10	11	2	2	2	12	12	5	2	7
																5

FIGURE 4 . SUMMARY OF SOIL SIGNATURES IN ERTS BAND 7  
(Frame 1033-15580)



TABLE II. PROCESSED ERTS DATA TRANSMITTED TO MSU

The following requested processed ERTS data products have been delivered by various means to MSU personnel in connection with ERTS Contract NAS5-21834.

A. Agriculture and Forestry Area of Frame 1033-15580 (Safir, Myers)

- (1) Digital gray maps of data in each ERTS channel:
  - (a) Lines 1300-1625, Points 1-120  
4 copies each, 16 Total (Delivered 2/05/73)
  - (b) Lines 1300-1625, Points 121-245  
4 copies each, 16 Total (Delivered 2/20/73)
- (2) Initial recognition map for 6 classes
  - (a) Lines 1200-1700, Points 1-120  
No Rejection threshold, 4 copies (Delivered 2/5,7/73)
  - (b) Lines 1300-1625, Points 1-240  
0.001 Rejection threshold, 1 copy (Delivered 2/7/73)  
0.01 Rejection threshold, 1 copy (Delivered 2/7/73)
- (3) Recognition map for 12 signatures, 7 classes, dated 2/7/73  
Lines 1300-1624, Points 1-120 and 121-240
  - (a) 0.001 Rejection threshold, 1 copy (Delivered 2/14/73)
  - (b) 0.01 Rejection threshold, 1 copy (Delivered 2/14/73)
- (4) Recognition map for 7 signatures, 7 classes, dated 2/12/73  
Lines 1300-1624, Points 1-120, 121-240
  - (a) 0.001 Rejection threshold, 1 copy (Delivered 2/15/73)
  - (b) 0.01 Rejection threshold, 1 copy (Delivered 2/15/73)
- (5) Recognition maps for 12 signatures, 7 classes, 0.001 threshold  
Lines 1300-1624,
  - (1) Points 1-125 1 copy (Delivered 2/24/73) (774 Rejected)
  - (2) Points 126-250 1 copy (Delivered 2/24/73) (641 Rejected)
  - (3) Points 86-210 2 copies (Delivered 2/24/73) (657 Rejected)
- (6) Recognition maps for 7 signatures, 7 classes, 0.001 threshold  
Lines 1300-1624,
  - (1) Points 1-125 1 copy (Delivered 2/24/73) (1943 Rejected)
  - (2) Points 126-250 1 copy (Delivered 2/24/73) (1681 Rejected)
  - (3) Points 86-210 2 copies (Delivered 2/24/73) (1638 Rejected)

TABLE II . PROCESSED ERTS DATA TRANSMITTED TO MSU (Continued)

- (7) Graymap, Channel 5, Lines 900-1700, Points 441-815,  
(Includes Soils Area) 1 copy  
(Delivered to W. Myers on 3/20/73)
- (8) Recognition Map with Sparse Forest Signature  
Lines 1300-1625, Points 1-125, 126-250, 1 copy  
(Delivered to W. Myers on 3/20/73)
- B. Soils Area of Frame 1033-15580 (Whiteside)
  - (1) Digital gray maps of data in each ERTS channel  
Lines 1100-1324, Points 500-624, 625-749, 2 copies  
(Delivered 2/05/73)
  - (2) Recognition map for 4 soil classes only, dated 2/7/73  
Lines 1100-1324, Points 500-624, 625-749
    - (a) 0.001 Rejection threshold, 2 copies (Delivered 2/5,7/73)
    - (b) 0.01 Rejection threshold, 2 copies (Delivered 2/7/73)
    - (c) 0.05 Rejection threshold, 1 copy (Delivered 2/13/73)
    - (d) 0.10 Rejection threshold, 1 copy (Delivered 2/13/73)
  - (3) Analog thermal ratio map of aircraft data of 10/19/72
    - 1 contact print (Delivered 2/6/73)
    - 1 transparency (original on loan) (Delivered 2/7/73)



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Progress During the Period, 1 February - 21 March 1973

One critical problem in the assessment of recognition results and the analysis of area measurement accuracies is the assignment of ERTS MSS pixels to specific fields or plots for which "ground truth" information is available. To date, this assignment has been performed manually by comparing digital line-printer maps with aerial photographs. Such work is tedious and subject to error.

During this reporting period, we began to consider improved methods for making such assignments.

Plans for the Next Reporting Period

One promising method for digitizing field vertices on aerial photographs and converting them to ERTS MSS line and point numbers will be investigated. We also will cooperate with MSU personnel in their development of a data analysis plan for the contract.

Prepared by: William A. Malila  
William A. Malila  
Associate Research Engineer

Approved by: Jon D. Erickson  
Dr. Jon D. Erickson  
Research Engineer

Approved by: Richard R. Legault  
Richard R. Legault  
Director  
Infrared & Optics Division